Szacillo, D. Mielzynska, E. Siwinska, J.A. Sokal, Institute of Occupational Medicine and Environmental Health, Sosnowiec, Poland

Polycyclic aromatic hydrocarbons (PAHs) are the main ingredient of coke oven emissions. Benzo(a)pyrene was used as the indicator of exposure and carcinogenic activity of all PAHs. Urinary 1-hydroxypyrene (1-OHPyr) was proposed by Jongeneelen as a biological marker of PAHs (BEL, 2.3 mmol 1-OHPyr/mol creatinine). The aim of our study was to estimate the exposure to PAHs based on monitoring of the air at the workplace (the concentrations of total dust and benzo(a)pyrene) and the biological monitoring (urinary 1-OHPyr of exposed population). Particulates were collected using personal air samplers on a glass fiber filter during whole work shift. Urine samples were collected twice: post shift after 4 consecutive days (I series) and then after 5 days of staying in the hospital (II series). BaP concentration was determined by high performance liquid chromatography (HPLC) and spectrofluorimetric detection (SFD). After cleaning with solid phase extraction (SPE) the urinary 1-OHPyr was analyzed by HPLC and SFD. Detection limit of BaP was 0.01 mg/m^3, 1-OHPyr - 0.1 mg/L of urine.

Concentration of the total dust ranged from 1.52 to 25.71 mg/m^3 and BaP ranged from 0.51 to 44.25 mg/m^3. The observed range of 1-OHPyr in urine was from 0.61 to 48.45 mmol/mol creatinine after work (I series) and from 0.20 to 4.80 mmol/mol creatinine after staying in the hospital (II series).

It was concluded that the difference between 1-OHPyr concentration in the urine of the workers exposed to PAHs and the workers not exposed demonstrates the usefulness of this biomarker determination in the urine as the indicator of PAH exposure.

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ENVIRONMENTAL AND BIOLOGICAL MONITORING OF COKE-OVEN WORKERS OF TWO DIFFERENT COKE-PLANTS. J.A. Sokal, D. Miel)yñska, E. Siwiñska, A. Bubak, E. Smolik, Institute of Occupational Medicine and Environmental Health, Sosnowiec, Poland

There is good epidemiological evidence that coke oven workers have a five- to tenfold increased lung cancer risk connected with occupational exposure to complex mixtures containing polycyclic aromatic hydrocarbons (PAHs). The low cure rate associated with these diseases has forced researchers to focus efforts on developing biological indicators of carcinogen exposure. The objective of the study was to compare the exposure of coke-oven workers to PAH at two different Polish coke plants. The exposure was estimated by the measurement of benzo(a)pyrene (BaP) concentration in personal samples of the work atmosphere and urinary mutagenicity by the Ames assay. Twenty-four workers from coke plant A (one of the most outdated) and 19 workers from plant B (one of the most modern plants) participated in the study. The workers were classified into three job categories: (1) workers of topside oven, (2) workers of side of oven, and (3) gas fitting operators. BaP concentrations in breathing zone air of coke-oven workers ranged from 0.04 to 44.1 mg/m^3 at the plant A and from 0.1 to 13.1 mg/m^3 at the plant B but the difference was significant only for the workers classified as an A job category. Polish TLV for BaP (2.0 mg/m^3) was exceeded in 70% (plant A) and in 53% of samples (plant B). Mutagenic effect of pooled samples collected from coke-oven workers at the end of shift, expressed as mutagenic activity/24 mL of urine ranged from 0.5 to 8.6 (median 2.7) at plant A and from 0.4 to 10.2 (median 1.8) at the plant B but the differences were not significant. The results of environmental and biological monitoring tended to increase in the group of workers of the old coke plant A; however, the increase was often statistically insignificant.

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EVALUATION OF DERMAL MEASUREMENT FOR WORKERS IN BENZIDINE MANUFACTURING FACTORY. J.H. Roh, H.K. Yeom, J.S. Song, C.N. Kim, J.W. Won, Institute for Occupational Health, Yonsei University College of Medicine, Seoul, Korea

This study was performed to evaluate the usefulness of dermal measurement of benzidine and benzidine-based dye as one of the occupational exposure assessment methods for these compounds. We selected one benzidine manufacturing factory and one dye manufacturing factory in Seoul area. Seven workers were for benzidine manufacturing factory and 28 for dye. We analyzed relationships among air level, amount on skin, and concentration of urinary metabolites for these compounds. Airborne levels of benzidine and dye were measured by NIOSH methods. Amount of these compounds on skin was measured with skin wipe method. Concentration of benzidine metabolites in urine was measured by high performance liquid chromatography after alkaline hydrolysis.

The amount of benzidine on skin was increased by increment of airborne level of benzidine. The amount of benzidine on skin has positive correlation with concentration of urinary metabolites for benzidine workers. The amount of dye on skin was high when airborne level of dye was high. The amount of dye on skin has positive correlation with concentration of urinary metabolites for dye workers. Also, a positive correlation was found between the amount of dye on skin and concentration of metabolite in urine.

When assessing the exposure of workers who deal with benzidine, the amount of benzidine on skin should be measured for an accurate exposure assessment.

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REDUCING CHROMATE EXPOSURES DURING THE DEPAINTING AND PRIMING OF FIGHTER AIRCRAFT. E.C. England, G.N. Carlton, US Air Force, Brooks AFB, TX

The focus of this exposure and control strategy assessment were military fighter aircraft corrosion control facilities involved in the depainting, priming, and painting of F-16 aircraft. The assessment was accomplished because military aircraft exteriors are primed with strontium chromate containing primers, the Air Force has adopted the ACGIH exposure guideline for strontium chromate (0.5 micrograms/m^3) as an occupational exposure limit, and previous air monitoring during corrosion operations showed high levels of airborne chromates. Measurements were made to determine exposure concentrations before and after engineering and administrative controls were put in place.

Exposure assessments were made during the four primary tasks of surface preparation, dust removal, priming, and painting. Breathing zone air samples for total chromium (analyzed using NIOSH Method 7300) were collected over the length of the tasks while worker activities were monitored using a video cassette recorder. The results indicate the greatest exposures were during priming while the greatest reductions in exposure occurred during dust removal. In one facility, maximum task exposures to total chromium (in micrograms/m^3) before controls were recorded as: sanding 18.1; dust removal 245; priming 625; and painting 5.3. Maximum task exposures to total chromium (micrograms/m^3) after applying engineering and administrative controls were: sanding 3.8; dust removal 4.1; priming 86.3; and painting 6.9. The study concludes the implementation of engineering and administrative controls such as high-efficiency vacuum cleaners, painter positioning, and reduced primer application rates can result in reduction of worker exposures to chromates up to 80%. The controls and techniques suggested in this study can be applied throughout the DoD and the small aircraft industry to reduce worker exposures to chromates and other harmful particulates.

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CARBON MONOXIDE POISONING FROM SMALL GASOLINE-POWERED ENGINES: A CONTROL TECHNOLOGY SOLUTION. R.J. Kovein, G. Earnest, R. Mickelsen, D. O'Brien, NIOSH, Cincinnati, OH

Carbon monoxide (CO) is a lethal poison that is produced when fuels such as gasoline are burned. It is one of many chemical found in engine exhaust and can rapidly accumulate, even in areas that might appear to be well ventilated. Because CO is colorless, tasteless, odorless, and nonirritating, it can overcome the exposed person without warning. Many workers have been poisoned by CO while using gasoline-powered tools such as high-pressure washers, cement-cutting saws, power trowels, floor buffers, welders, pumps, compressors, and generators in buildings or semienclosed spaces. Many of the poisonings have occurred in the construction industry and agriculture.

Hundreds of people have been poisoned because they did not recognize the danger of using small, gasoline-powered engines in poorly ventilated areas. For example, in Colorado 40% (135) of all work-related CO poisonings reported to the Colorado Department of Public Health and Environment since 1985 have been related to the use of gasoline-powered equipment. Seventeen of these 135 workers lost consciousness during their exposure to emissions from this equipment and 2 workers died.

NIOSH researchers have successfully developed an engineering control for retrofitting gasoline-powered tools that frequently cause CO poisoning. The engineering control consists of a commercial CO sensor used in home alarms and was tested on a five-horsepower engine. Instead of using the sensor to warn, additional electronic circuitry has been developed to automatically disable the ignition system of a gasoline-powered engine, causing it to shut down. The ignition system remains dis-

abled until the CO concentration falls below a preselected threshold value. By preventing the generation of potentially lethal gases, the users of these gasoline-powered tools will be protected from acute illness or even death. Additionally, flashing lights and audible alarms were used as a warning during the buildup of hazardous CO concentrations. This control could be adopted by the manufacturers of power tool equipment as a means of reducing the number of CO poisonings that occur every year with these tools, thereby reducing their product liability risks.

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STATE-OF-THE-ART FACILITY DESIGN FOR CONTROL OF BERYLLIUM AEROSOLS. K.L. Creek, Los Alamos National Laboratory, Los Alamos, NM

The Beryllum Technology Facility located at Los Alamos National Laboratory was designed for the U.S. Department of Energy to support weapons-related activities and scientific development of beryllium metals, alloys, and products. Current beryllium industry practice uses exposure minimization techniques. This practice is described in the U.S. Department of Energy Notice 440.1, "Interim Beryllium Disease Prevention Program." The Beryllium Technology Facility design allows for a state-of-the-art, aggressive beryllium control program with the objective of effectively managing the work environment so there are no new cases of chronic beryllium disease. In addition, the facility is designed to allow for compliance with the notice by minimizing beryllium aerosols, and limiting the number of individuals potentially exposed and the number of instances of exposure. Primary control features include a robust and flexible ventilation system, in-house beryllium analytical laboratory, in-house laundry facility, change room and locker room, a paperless industrial hygiene data management system, personal decontamination bay, and limited access. Other features that allow for exposure minimization include surfaces that are easy to clean, a supplied-air breathing system, and closed-circuit television. Waste minimization is practiced by collecting fines with cyclones and filtration, using extensive recycle capabilities, and limiting use of disposable personal protective clothing.

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CONTROLLING ASBESTOS FIBER RELEASES WHEN MAKING PENETRATIONS IN PLASTERS CONTAINING 0.4B0.6% ASBESTOS. T.C. Ouimet, R.C. Klein, Yale University, New Haven, CT

This report summarizes the results of a study to (1) estimate typical asbestos exposures of tradesman drilling holes, setting screws, and coring holes in plasters containing 0.4-0.6% asbestos; and (2) identify tools, control equipment, and techniques that can be utilized by tradesman to control asbestos fiber releases below 0.1 fpcc (and if possible 0.01 fpcc) when making these intrusions. Different tools, control equipment and techniques were screened, utilizing a real time dust monitor and gypsum board, to identify those most likely to be successful when intruding on asbestos containing plaster. Each variation of tool, control equipment, and technique was videotaped while the dust level at the tool's point of operation was monitored and video recorded simultaneously. The most successful tools, control equipment, and techniques were then tested on plaster containing between 0.4-0.6% asbestos. The airborne fiber concentrations (measured and analyzed according to NIOSH 7400) during continuous hole drilling and setting screws were less than 0.01 fpcc when using a locally exhausted bellows shroud (drill) and screwing though duct tape (setting screws). Fiber concentrations were controlled at 0.1 fpcc when continuously coring 2-inch holes through walls with the use of local exhaust ventilation at the point of operation (through coring bit). The airborne fiber concentrations during these controlled procedures compared favorably (two- to threefold reduction) with the fiber concentrations generated during similar uncontrolled continuous operations (no dust controls) — drilling and coring (0.2-0.3 fpcc), setting screws (0.05 fpcc).

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COMPARISON OF METALWORKING FLUID MIST EXPOSURE FROM MACHINING WITH DIFFERENT LEVELS OF MACHINE ENCLOSURE. J.N. Capuzzi, CIGNA Loss Control Services, Upper Darby, PA; M. Sheehan, West Chester University, West Chester, PA

This research evaluated the effectiveness of machine enclosures in reducing employee exposure to metalworking fluid mist. Forty-two personal air samples collected over a 4-year period at an industrial pump manufacturing facility were placed into three categories depending on the type of engineering control at the sampled operation. The categories were "enclosed," "splash guarding," and "no enclosure." Enclosed machines were defined as having original equipment manufacturer enclosed points-of-operation. Machines with splash guards were equipped with original equipment manufacturer splash guarding or retrofit splash guarding. The category "no enclosure" consisted of operations where machinery was not enclosed.

The results of the Mann Whitney U test indicated that the exposure while operating equipment with enclosures was not significantly different from that measured at equipment with no enclosures at the 0.05 significance level (p=0.0827). The observed significance levels determined by the Mann Whitney U test fail to show a significant difference between enclosures and splash guarding (p=0.2847). The Mann Whitney U test also failed to show a significant difference between enclosures and the combined data set of no enclosures and splash guarding (p=0.1203).

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CAPTURE EFFICIENCY OF A VENTILATED TABLE FOR STYRENE EMISSION IN THE REINFORCED PLASTIC INDUSTRY. L.P. Lazure, Institut de recherche en santé et en securité du travail (IRSST), Montreal, Quebec, Canada

Reinforced plastics are used for manufacturing a large variety of products, particularly vehicle, boat, and architectural components. The low cost/effectiveness ratio that characterizes their use makes them a preferred finished product due to superior strength and dimensional stability properties, and their rapidity of manufacture.

Hand lay-up and spray-up molding are the main methods of manufacture. These processes generate significant quantities of styrene, and according to the Environmental Protection Agency, the amount by weight likely to be given off from the standard resin is in the order of 5 to 10% in lay-up molding, and 9 to 13% in spray-up molding.

In Quebec more than 3000 workers work in the reinforced plastic industry. Statistical analysis of the styrene concentrations evaluated over a period of 5 years by IRRST reveals, for all of the main manufacturing sectors involved, that between 40 and 78% of the results exceed the exposure standard of 50 ppm.

The collection device consists of a 1.2 m H 1.2 m ventilated table. In hand lay-up molding, the emission are sucked though the grid surface as well as through the two side openings located at one end of one side.

The collection efficiency was evaluated for two types of molds. Without ventilation, the results indicate average styrene concentrations as high as 125 ppm and peak values of 650 ppm. The results obtained indicate that styrene concentrations can be reduced by 90% when exhaust ventilation is operating. The introduction of air allows the concentrations to be reduced by 95%.

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COMPARISON OF TROUBLESHOOTING METHODS FOR TWO SYSTEMS IN VENTILATION LABORATORIES. S.E. Guffey, University of Washington, Seattle, WA

This study compared the efficiency of four methods of troubleshooting exhaust ventilation systems using measured pressures and flows. In addition to the typical use of hood static pressures (SPH) and an idealized form of the Industrial Ventilation (IVM) commissioning method, both of which assume that SPH values always decline if a duct is obstructed, we tested a variant wherein changes in SPH up or down were considered. In addition, we tested the observed equivalent duct resistance (X) and the ratio of SPH to the static pressure at the end of the duct (SPend).

A pitot traverse was performed and values of SPH and SPend were measured for each branch duct of two systems installed in different ventilation laboratories. One system had five branch ducts; the other had eight. The conditions for the five-branch system included (a) dampers on most branches adjusted to three sets of insertion depths while airflows were varied at the fan by as much as 50%, and (b) blanking off one branch duct at a time. For the eight-branch systems, airflows were adjusted to four different airflow distributions using dampers.

Thus, for every duct, it was known whether an alteration had occurred (positive) or not (negative). Using the observed pressures and flows, each method assigned a positive if a threshold value was exceeded. Thus, sensitivity and false positive rate could be computed for each method for a broad range of thresholds. By integrating the area under the curve when sensitivity was plotted against false positive rate, it was possible to generate an integrated score of efficacy, simplifying comparisons.

The area under the curve was substantially better for the equivalent resistence value (96% overall) and the SPH/SPend (92%) methods than for the typical SPH method (24%), two-sided SPH method (74%), and IVM (<20%) method.

Abstracts

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